

**Characterization of The Film Formed on  
Nickel Base Alloys in Sulfur Containing  
Solutions by AES and XPS**

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Passive films on Alloy 600 is being investigated to determine the effects of sulfur valence on the passivity. Sulfur valence is introduced by the use of different ions (SO<sub>4</sub><sup>2-</sup>, SO<sub>3</sub><sup>2-</sup>, S<sub>4</sub>O<sub>6</sub><sup>2-</sup>, S<sub>2</sub>O<sub>3</sub><sup>2-</sup> and HS<sup>-</sup>) to obtain valences of +6, +4, +2.5, +2 and -2. These effects are being correlated with the structure of the films based on examinations by both AES and XPS. The passive film structure of Alloys 600, 690 and 800 formed in sulfur- containing solutions is also studied at different potentials to determine the correlation between the film structures and passivity and transient passivity. The depletion of Cr in the film formed in S<sub>2</sub>O<sub>3</sub><sup>2-</sup>, and HS<sup>-</sup> is the main reason for reducing passivity of Alloy 600.

The results show that the films formed on Alloy 600 in solutions of sulfur species at 100mV are composed of hydroxides (Cr, Ni and Fe), oxides (Cr, Ni and Fe) and sulfides (Ni and Fe) with a higher fraction of the hydroxides relative to the oxides. Increase of the depth from the film surface, the fractions of oxides and sulfides increase; whereas, the fractions of hydroxides decreases. Sulfides are incorporated in the oxides and hydroxides mainly in the inner layer of the film, which cause a discontinuity of the passive film. The maximum amount of oxygen in the films formed on Alloy 600 exposed to various valence of sulfur solutions decreases with reduced sulfur valence. The maximum concentration of sulfides in the films increases with reduced sulfur valence. It is found that the significant increase in S-M signal corresponds to the peaks in the film instability parameter, PSCC.